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## EUROPEAN PATENT APPLICATION

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㉖ Applicant: ALCATEL DIAL FACE S.P.A.  
Via Achille  
I-20151 Milan (IT)

㉗ Inventor: D'Avolio, Antonio

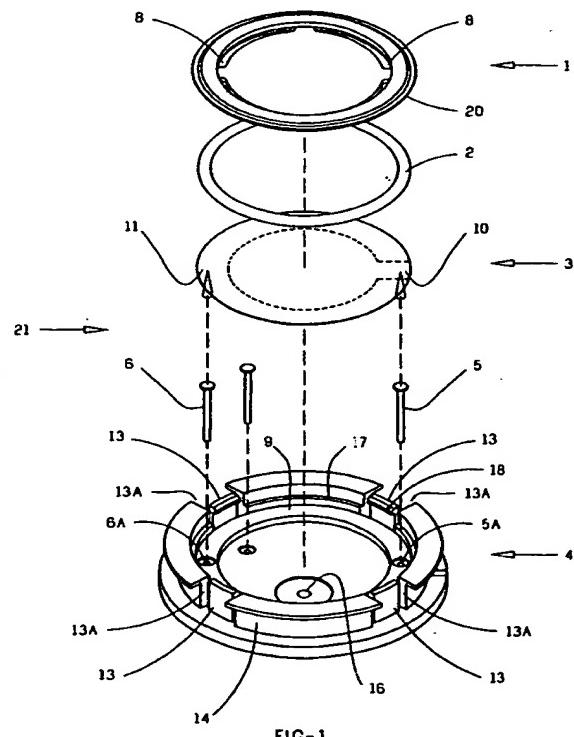
Via Cicolana, 48  
I-67062 Magliano dei Marsi (AQ) (IT)  
Inventor: Pesenti, Luigi  
Via Cenisio, 32  
I-20154 Milano (IT)

㉘ Representative: Pohl, Herbert, Dipl.-Ing et al  
Alcatel SEL AG  
Patent- und Lizenzwesen  
Postfach 30 09 29  
D-70449 Stuttgart (DE)

### ㉙ Piezoceramic capsule for telephone instruments.

㉚ A piezoceramic capsule for telephone instruments, of the type comprising a terminal-holder spool, a piezoceramic diaphragm in pressure contact with nail-shaped feed-through terminals forced in the spool, an elastic O-ring for producing the contact pressure and a perforated case housing them, is modified to transform the case into a cover-up disc and the spool into a case being provided with a stepped cylindric cavity designed to house, from the bottom to the top, respectively the diaphragm, the elastic O-ring and the cover-up disc.

A plurality of resilient pawls are formed by pressing inside respective cuts provided in the sidewall of the opening of said cylindric cavity and designed to snap on said cover-up disc in a closure position.



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The present invention relates to a piezoceramic capsule for use in telephone instruments, of the type including a bottom base in the form of a terminal-holder spool, a piezoceramic diaphragm pressed in contact with two nail-shaped terminals forced into the spool in axial direction, an elastic O-ring for generating the necessary contact pressure and a perforated case, whose openings allow the transmission of acoustic waves generated by the vibrations of the diaphragms disposed in such a way as to maintain said elastic O-ring in contact with said diaphragm.

Such a capsule is disclosed e.g. in the Italian patent application for Utility Model No. 21175-B/90 filed by the Applicant, which could be referred to for further details.

Therein the case made from insulating material acts as a container for the other members and it is provided on its perforated wall with an annular housing extending coaxially thereto, with a reference tooth designed to engage in a corresponding notch provided on the spool to assure the correct positioning of the latter during the assembly of the capsule, and with an annular extension designed to snap on external face of the spool and secure it.

This type of capsule as disclosed in the above-mentioned application, when positioned in the corresponding seat of the handset requires a further gasket for seal.

In an advantageous embodiment also described and illustrated in the above-mentioned application, the case is formed directly on the bottom of the handset housing by pressing. In this circumstance the additional gasket is no longer necessary, but the automation of the capsule assembly is affected since the relative operations are tied to the type of the handset.

An object of the present invention is to provide a piezoceramic capsule of the type mentioned at the outset which is so conceived as to be free from the type of handset, to simplify the automation of the assembly operations and to avoid the use of an additional gasket when mounting the capsule into the handset.

Another object of the present invention is to provide a piezoceramic capsule of the type mentioned above which allows cost reduction.

The above-mentioned objects are obtained in accordance with the present invention by a piezoceramic capsule for telephone instruments which is characterized in that the case is substantially shaped like a cover-up disc and said spool is adapted to house, in a cylindric cavity hollowed out in its end face adjacent to said diaphragm, respectively from the bottom to the top, said diaphragm, said O-ring and said cover-up disc and to retain the same assembled with a slight preloading on the O-ring.

Further characteristics and advantages of the invention are pointed out hereinafter with reference to the accompanying drawings in which :

Fig. 1 is an exploded perspective view of the piezoceramic capsule according to the invention;

Fig. 2 illustrates the capsule of Fig. 1 mounting an additional coil to operate a deaf prothesis; are two views, in partial cross section, that show the assembly of the capsule of Fig. 1; and

Fig. 5 is a cutaway which illustrates the mounting of the capsule assembly inside the seat provided in the housing of a telephone instrument.

Referring now to figs. 1 and 2, the capsule is denoted in its entirety by 21. It includes a bottom base 4 in the form of a circular spool made from plastic through presssing process which in the realization in accordance with the present invention, originally acts also as a casing, a piezoceramic transducing diaphragm 3 of composite type, an elastic member 2 in the form of O-ring made from elastomeric material, and finally a perforated case 1 which, originally in accordance with the invention, has the simple form of a cover-up disc.

Spool 4 has conventionally a circumferential groove 14 designed to house the coil 15 (optional) for operating a deaf prothesis, two through-holes 5A, 6A extending in an axial direction, inside which respective nail-shaped terminals 5, 6 are forced, and a third additional hole 7A for the auxiliary terminal 7 to be connected to an end of the optional coil 5 and, finally, a still axially extending through-hole 16 designed to achieve damping of microleaks of diaphragm 3.

In the embodiment in accordance with the present invention, hollowed out in the end face of the spool is a cylindric cavity coaxial with the spool and designed to house, when the capsule is assembled and from the bottom to the top, the diaphragm 3, the O-ring 2 and the perforated cover 1. More specifically, the internal wall of the cavity is stepped being formed by three sections S1, S2, S3 having diameters in mounting progression, the interface between the internal section S1 having the smallest diameter and the intermediate section S2 forming a first step 9 crossed by axially extending holes 5A, 6A of peripheric terminals 5, 6 (see figs. 1, 3) and on which diaphragm 3 abuts with its circumferential portion comprised between the ceramic substrate 12 and the external edge, suitably oriented so its poles 10, 11 abut on the heads of the nail-shaped terminals 5, 6 respectively. A second step 17 formed at the interface between inter-

mediate section S2 and the external section S3, at a distance from the first step 9 approximately equal to the radius of the cross section of the O-ring plus the thickness of the diaphragm, serves as an enlargement for housing the perforated cover which has a diameter slightly greater than the diaphragm's diameter (see Fig. 4).

Machined in that portion of spool, which is comprised between the external perimeter and the opening of the cylindric cavity, are four radial cuts 13A extending in an axial direction and preferably 90 degree spaced away each other. The depth of these cuts is greater than said stepped cavity depth.

Housed inside these cuts are as many resilient pawls 13. These are blade-shaped and extend in an axial direction up to the bottom of the cuts. One of their end is rigidly fixed to the spool body while their free end is movable in a radial direction. The latter is bent towards the inside of the outer section S3 of the cylindric cavity in such a way as to form an abutment step 19 that holds the cover-up disc once assembled (see Figs. 3 and 4) and is disposed at such a distance from the first step 9 as to maintain a slight preloading on the elastic O-ring (see Fig. 4).

Said bent end has further a chamfer 18 converging towards the center of the cavity and whose function is to facilitate the introduction of the cover 1 into the cylindrical cavity during the assembly.

Advantageously, the resilient pawls are obtained during the forming of the spool by pressing.

In the realization in accordance with the invention, the perforated cover 1 is formed by pressing as a simple cover-up disc suitably shaped. It has four openings 8 in the form of sector of an annulus to allow the transmission of the acoustic waves produced by the vibrations of diaphragm 3, disposed along a circumference near the external edge and it is provided with a chamfer 20 converging towards the inside of the capsule (see Figs. 1, 4) substantially parallel to chamfer 18 on the top of resilient pawls 13.

The capsule according to the invention can be easily assembled in an automated manner.

Once positioned the spool, feed-through terminals are forced into respective holes, the auxiliary coil (if required) is wound up, the diaphragm already oriented is automatically introduced by the assembling machine, the elastic ring is then introduced and finally the cover. Sliding of the chamfer of the cover on the corresponding chamfer of the elastic pawls (see Fig. 3) causes the broadening of the latters and the subsequent snap action through the abutment step of the resilient pawls (see Fig. 4).

The capsule is thus assembled and can be mounted in the corresponding seat provided, e.g., on the

housing 22 of the handset where it is held in situ by a suitable detent 23 which is so positioned as to maintain compressed the elastic O-ring in order to assure the sealing (see Fig. 5). It is to be pointed out that because of the flattening of the O-ring 2, which besides sealing assures also the contact pressure on the diaphragm, the cover-up disc 1 is no longer in contact with the abutment step 19 of the pawls on the spool.

From the foregoing it is evident that the present invention full achieves all the objects mentioned at the outset; in fact the automation of the assembling operations is simplified since the capsule is not tied to the type of the handset housing, it does not require an additional gasket when mounted on the subset and it is cheaper thanks to the simplification of the cover and of the automatic assembly operations.

Moreover, it can be mounted on the handsets already in use which have the case directly formed in the housing of the handset, as disclosed in the patent application mentioned at the outset.

Naturally, materials, dimensions and construction details can be changed according to the circumstances and requirements of manufacturing and use without departing from the characteristics illustrated, described and claimed below.

### Claims

1. Piezoceramic capsule for telephone instruments of the type including
  - a bottom base in the form of a circular spool made of insulating material, provided with at least two nail-shaped feed-through terminals, forced into respective through-holes axially extending in said bottom base and diametrically opposite, said terminals being accessible from outside;
  - a piezoceramic diaphragm in the form of a disc having the central portion of a first face covered by a circular ceramic layer and having two poles located on said first face to be in pressure contact with the heads of said two nail-shaped terminals respectively;
  - an elastic element in the form of an O-ring disposed on the second face of said diaphragm and designed to produce the required contact pressure between said poles and said terminal heads; and
  - a perforated case provided with openings for the transmission of acoustic waves generated by the vibrations of diaphragm, disposed in such a way as to hold said elastic element in contact with said diaphragm;

said capsule being characterized in that:

- said case is substantially formed as a cover-up disc, and
- said spool is adapted to house, in a cylindric cavity hollowed out in its face adjacent to said diaphragm, respectively from bottom to top, said diaphragm, said O-ring and said cover-up disc and to hold the same assembled with a slight pre-loading on the O-ring.

2. Piezoceramic capsule according to claim 1, characterized in that said cylindrical cavity is stepped and formed by three sections with diameter increasing from the bottom to the top, said sections forming two steps, the first one at the interface between the innermost section with the smallest diameter and the intermediate section, serves to receive in abutment said diaphragm and the second step at the interface between the intermediate section and the outer one being located approximately at the middle of the cross section of said O-ring.

3. Piezoceramic capsule according to claim 2, characterized in that said innermost section of said stepped cavity has a diameter comprised between the diameter of said diaphragm and the diameter of said circular ceramic layer.

4. Piezoceramic capsule according to claim 1, characterized in that said cover-up disc has its outer edge provided with a chamfer converging towards the inside of the capsule.

5. Piezoceramic capsule according to claims 1 and 2, characterized in that the portion of spool comprised between the outer perimeter thereof and the inner wall of said intermediate cavity section is broken by a plurality of radial cuts axially extending up to beyond the bottom of said innermost cavity section, said cuts housing respective resilient pawls, elastically movable in a radial direction and designed to snap on the outer surface of said cover-up disc and hold it in a closure position when the capsule is assembled.

6. Piezoceramic capsule according to claim 5 characterized in that each of said resilient pawls is lamellar, axially extending towards the bottom of the respective cut, with a first end rigidly fixed to the body of the spool and the second end bent and converging towards the inside of said outer cavity section so as to form an abutment step designed to snap on said cover-up disc in such a way as to hold it with said slight pre-loading on said O-ring.

7. Piezoceramic capsule according to the preceding claims, characterized in that said bent end of said pawls has a chamfer converging toward the inside of said cavity designed to make easier the introduction into the latter of said cover-up disc during the assembly of the capsule.

8. Piezoceramic capsule according to claim 6, characterized in that said resilient pawls are obtained during the forming of the spool by pressing.

9. Piezoceramic capsule according to claim 8, characterized in that said resilient pawls are 90 degrees spaced out from each other.

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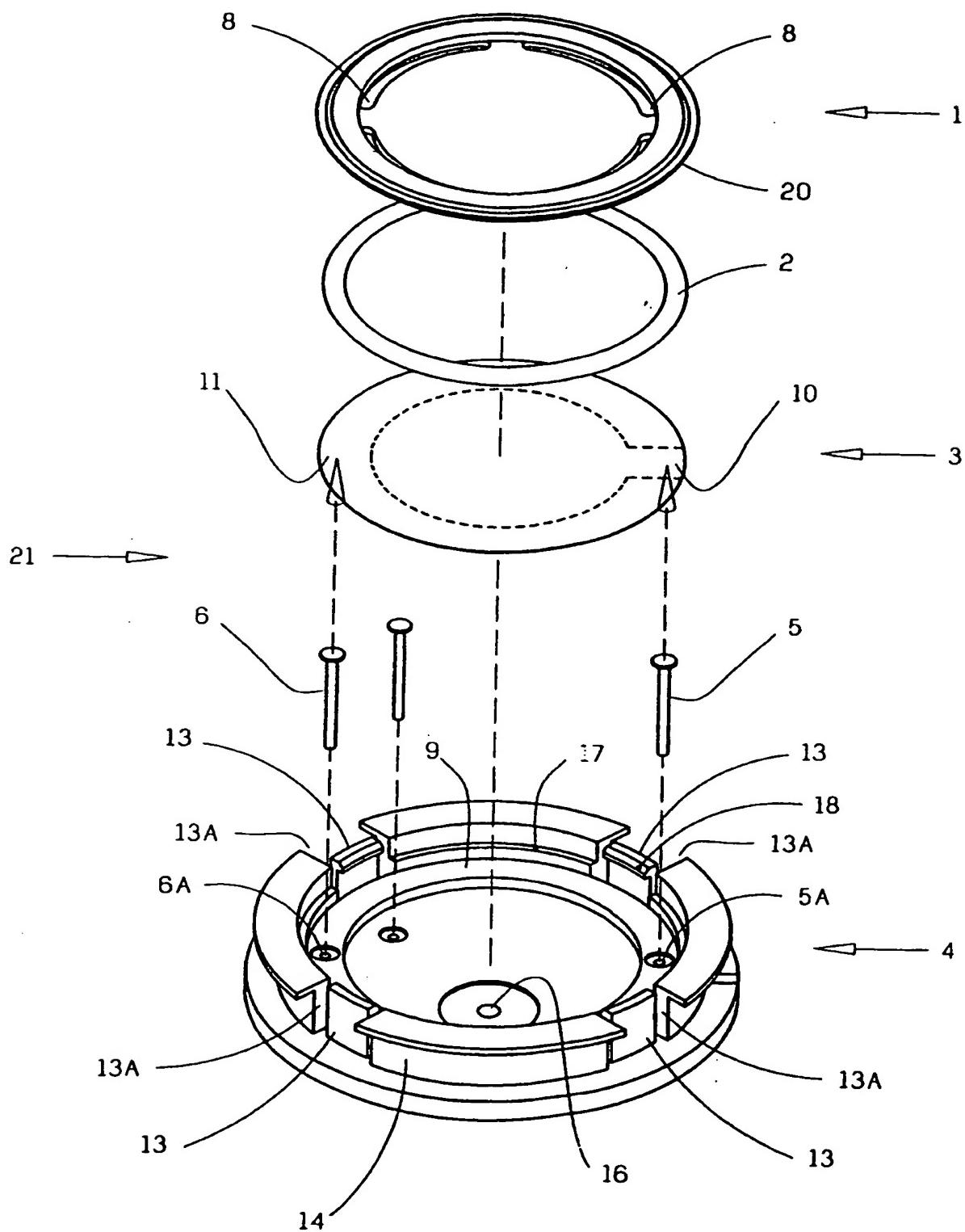


FIG-1

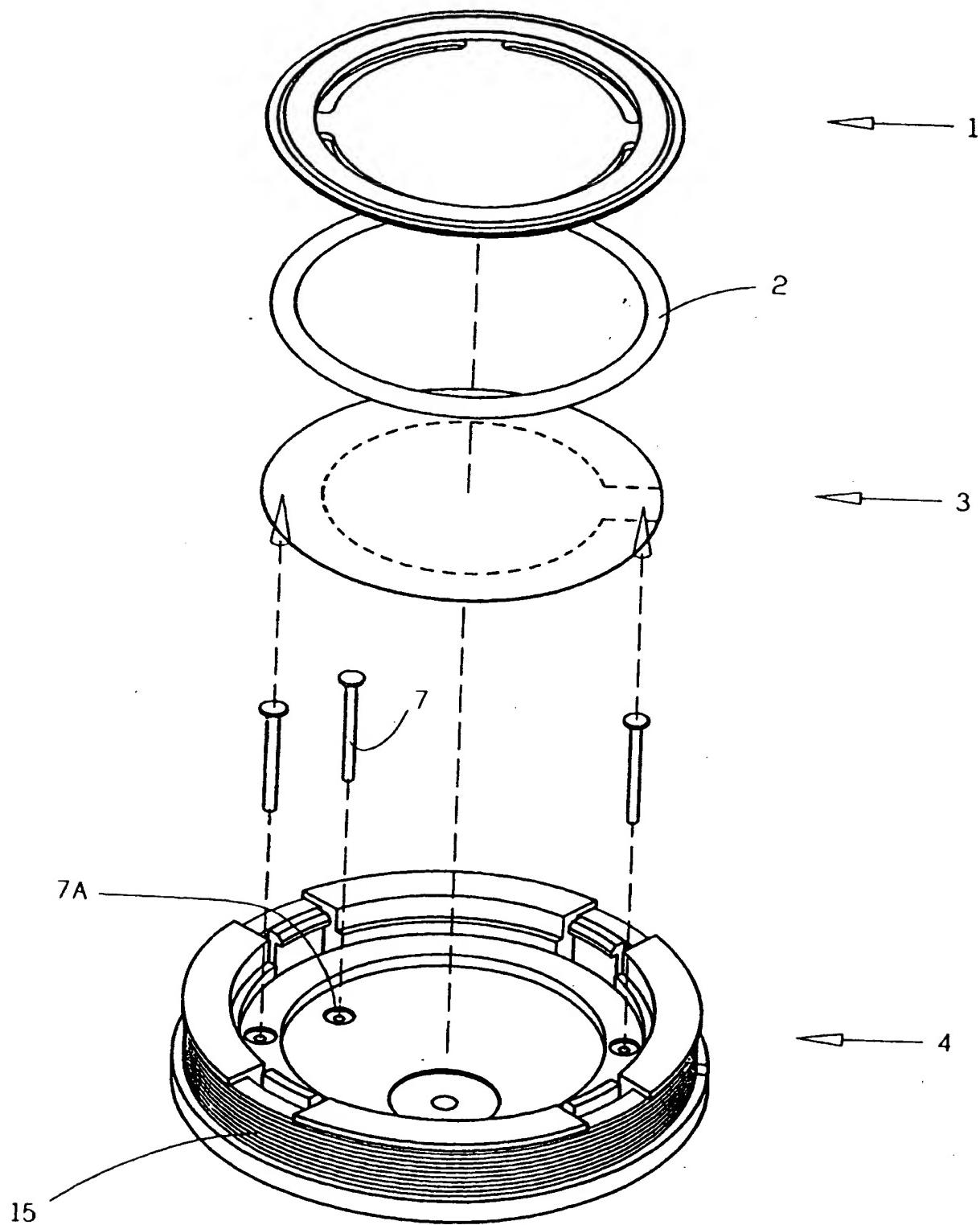


FIG-2

FIGURE 3

POSITIONING

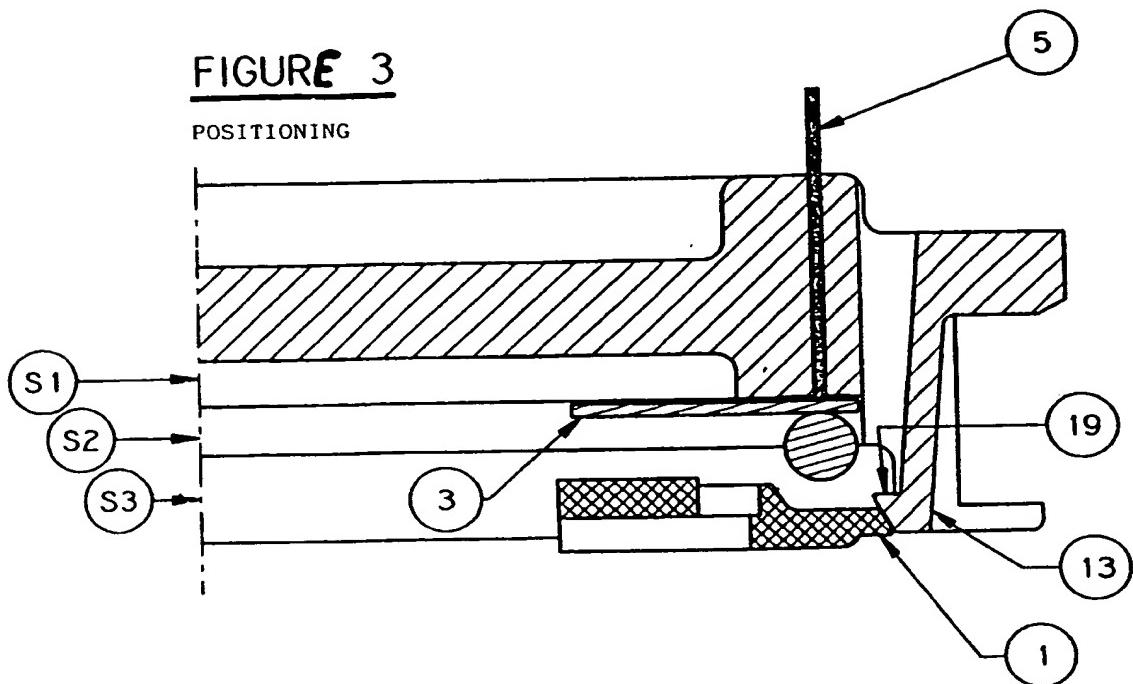


FIGURE 4

INSERTION

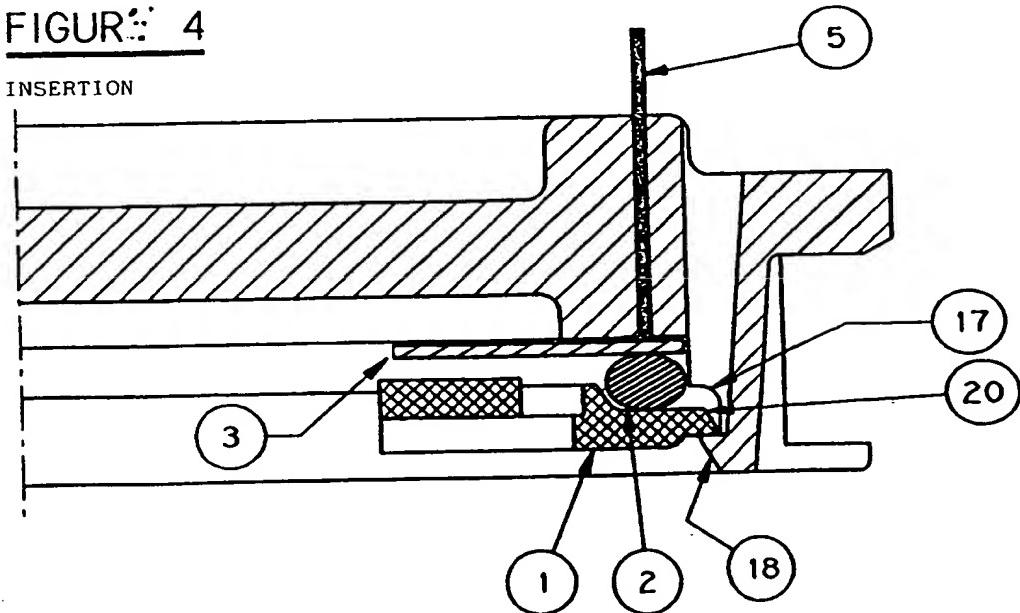
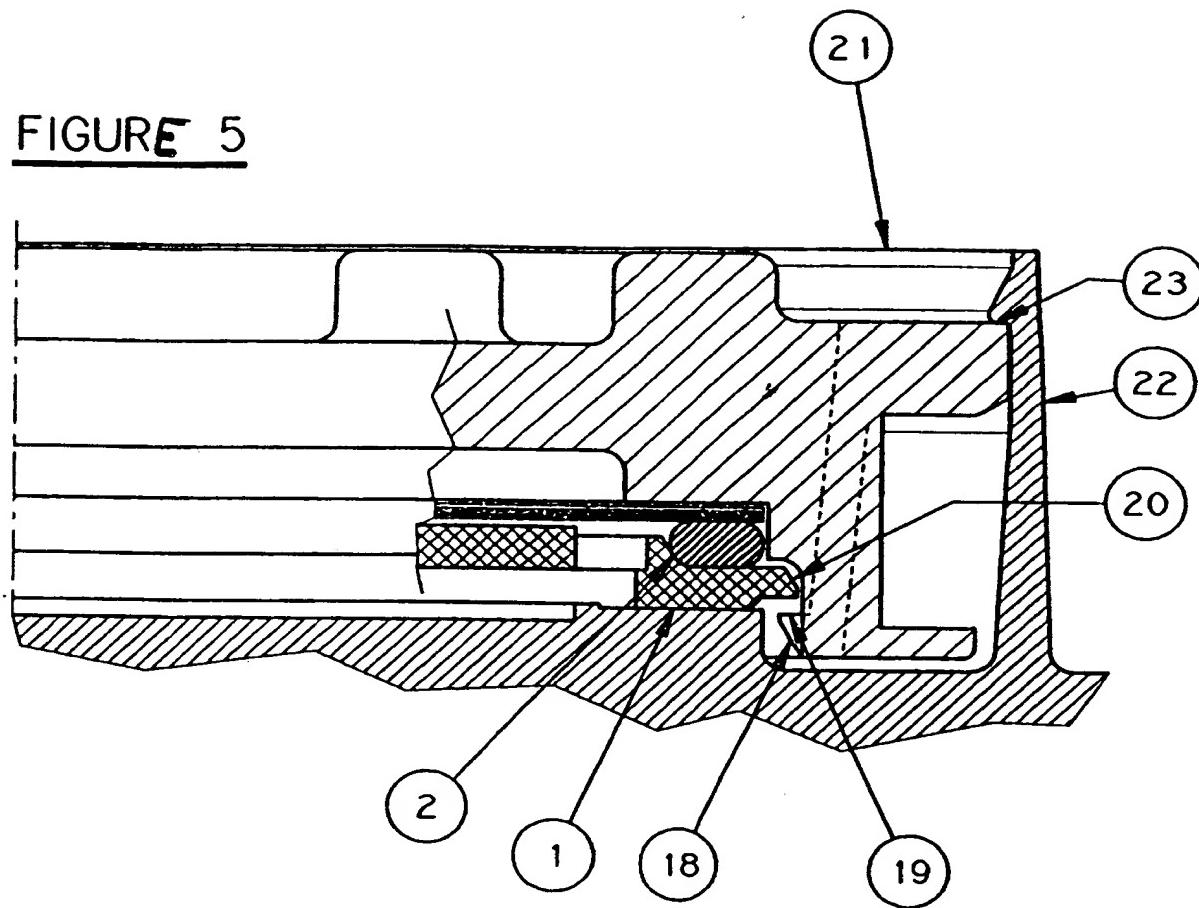


FIGURE 5





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## EUROPEAN SEARCH REPORT

Application Number  
EP 94 10 2787

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.CI.5)
A	EP-A-0 336 860 (HORLOGERIE PHOTOGRAPHIQUE FRANCAISE) * column 4, line 42 - column 7, line 7 * ---	1,4-9	H04R17/00 H04M1/03
A	DE-A-34 25 176 (FERNSPRECH UND SIGNALBAU) * page 8, line 16 - page 9, line 14 * ---	1-3	
A	DE-U-91 00 707 (SIEMENS) * page 1, line 6-11 * * page 3, line 35 - page 5, line 11 * -----	1,5-9	
TECHNICAL FIELDS SEARCHED (Int.CI.5)			
H04R H04M			
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	7 June 1994	Zanti, P	
CATEGORY OF CITED DOCUMENTS			
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T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons & : member of the same patent family, corresponding document			

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